

REMARKS

In the last Office Action, the Examiner rejected claims 1, 2, 4, 6, 7, 9 and 34 under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. Claims 1, 2, 7 and 9 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,513,219 to Katsuma et al. ("Katsuma"). Claims 1, 2, 4, 6, 7, 9, 34 and 35 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,140,215 to Yamaguchi. Additional art was cited of interest.

In accordance with the present response, independent claim 1 has been amended to further patentably distinguish from the prior art of record claim 1 has also been amended to delete the recitation directed to the piezoelectric vibrator being mounted "directly" on the substrate, thereby rendering the Section 112, first paragraph, rejection of claims 1, 2, 4, 6, 7 and 9 moot. As set forth in detail below, the prior art of record does not disclose or suggest the support member and corresponding functions, as well as the specific positional relationships between the support member, substrate and piezoelectric vibrator, recited in amended independent claim 1. Claims 34-35 have been canceled without prejudice or admission, thereby rendering the Section 112, first paragraph, rejection of claim 34 moot.

New claims 36-58 have been added to cover the subject matter of previously allowed claims 3, 5, 10-19 and 22-33. More specifically, claims 36, 37-40, 41, 42, 43, 44-53 and 54-58 are directed to the subject matter of previously allowed claims 33, 24-27, 3, 5, 22, 10-19 and 28-32, respectively. A new abstract which more clearly reflects the invention to which the amended and claims are directed has been substituted for the previously submitted abstract.

Applicants request reconsideration of their application in light of the foregoing amendments and the following discussion.

Brief Summary of the Invention

The present invention relates to an ultrasonic motor having improved vibration efficiency, and to an electronic apparatus having the ultrasonic motor.

A conventional ultrasonic motor includes an elastic member for resiliently biasing a piezoelectric element against a moving member to efficiently transmit a drive power caused by oscillation of the piezoelectric element to the movable member. The conventional ultrasonic motor relies upon expansion-and-contraction and flexural vibration of the piezoelectric element to drive the movable member and uses signal lines to transmit drive signals from a circuit board to the piezoelectric element.

The conventional ultrasonic motor is typically installed on a circuit board by means of a support member which holds the piezoelectric element to the circuit board. Additionally, signal transmission lines extend between the circuit board and the piezoelectric element separate from the support member for supplying a drive signal to the piezoelectric element.

As described at pages 1-2 of the substitute specification, the use of separate components to form the support member, the signal transmission lines, and the elastic member, results in a significant loss in expansion-and-contraction and flexural vibrations of the piezoelectric element. Thus, the general construction of the conventional ultrasonic motor lends to inefficient transmission of drive force from the piezoelectric element to the moving member and impairs the electrical-to-mechanical energy conversion.

The present invention overcomes the drawbacks of the conventional art by providing an improved ultrasonic motor construction which results in a reduced loss factor, thereby exhibiting an improved vibration efficiency.

A preferred embodiment of the invention embodied in amended independent claim 1 is illustrated in Fig. 1 of the application drawings and described at pages 9-11 of the substitute specification. The ultrasonic motor 1 has a movable member 12a disposed to undergo movement in response to

a drive force. A substrate 8 has a conductor pattern 7a-7e for conveying a drive signal from a drive circuit 6. A piezoelectric vibrator 10 undergoes oscillating movement in response to the drive signal from the drive circuit 6 so as to contact the movable member 12a and generate the drive force to drive the movable member 12a.

According to the present invention, a support member 11, 11 is provided on the substrate 8 for mechanically fixedly supporting the piezoelectric vibrator 10 only in a region thereof corresponding to a node of vibration of the piezoelectric vibrator 10. Transmission of the drive signal from the conductor pattern 7a-7e to electrodes of the piezoelectric vibrator 10 is effected only by the support member 11, 11 so that no conductor wires extend from the substrate 8 to connect the drive circuit 6 and the piezoelectric vibrator 10.

By the foregoing construction of the ultrasonic motor according to the present invention, the support member serves the dual function of supporting the piezoelectric element and transmitting the drive signal from the conductor pattern to the piezoelectric vibrator. As pointed out above, the use of signal transmission lines separate from the support member results in vibration loss. By combining these elements of the ultrasonic motor, vibration loss is reduced. Furthermore, by providing the support member

on the substrate for fixedly mechanically supporting the piezoelectric vibrator only in a region thereof corresponding to a node of vibration of the piezoelectric vibrator, vibration loss is further reduced. Accordingly, the present invention makes it possible to substantially reduce the size and part count of the ultrasonic motor and to reduce the loss associated with the use of multiple components as described above.

Traversal of Prior Art Rejections

Claims 1, 2, 7 and 9 were rejected under 35 U.S.C. §102(b) as being anticipated by Katsuma. Claims 1, 2, 4, 6, 7 and 9 were rejected under 35 U.S.C. §102(b) as being anticipated by Yamaguchi. Applicants respectfully traverse these rejections and submit that amended independent claim 1 and corresponding dependent claims 2, 4, 6, 7 and 9 recite subject matter which is not identically disclosed or described in Katsuma or Yamaguchi.

Amended independent claim 1 is directed to an ultrasonic motor and requires a movable member disposed to undergo movement in response to a drive force, a substrate having a conductor pattern for conveying a drive signal from a drive circuit, a piezoelectric vibrator for undergoing oscillating movement in response to the drive signal so as to contact the movable member and generate the drive force to

drive the movable member, and a support member provided on the substrate for mechanically fixedly supporting the piezoelectric vibrator only in a region thereof corresponding to a node of vibration of the piezoelectric vibrator. Amended claim further requires that transmission of the drive signal from the conductor pattern to electrodes of the piezoelectric vibrator is effected only by the support member so that no conductor wires extend from the substrate to connect the drive circuit and the piezoelectric vibrator. No corresponding structural and functional combination is disclosed or described by Katsuma and Yamaguchi.

Katsuma discloses an ultrasonic motor with a movable member 9 which undergoes movement in response to a drive force applied at patterned electrodes which form part of a writing plate or substrate 51 (Fig. 7). An absorber 4, which has been interpreted by the Examiner as corresponding to the support member recited in independent claim 1, is disposed between a vibrator 2, 3 and the substrate 51 for absorbing the vibration of the vibrator 2, 3 (col. 3, lines 67-68).

However, Katsuma does not disclose or describe a support member provided on the substrate for mechanically fixedly supporting the piezoelectric vibrator only in a region thereof corresponding to a node of vibration of the piezoelectric vibrator, as recited in amended claim 1. As shown in Fig. 7 of Katsuma, the absorber or support member 4

is positioned to be disposed over the entire vibrator 2, 3. Thus, the absorber or support member 4 does not support the vibrator 2 only in a region thereof corresponding to a node of vibration of the vibrator.

Yamaguchi discloses an ultrasonic motor in which support members supporting piezoelectric elements contact electrically to GND (Figs. 1, 4). Separate conductor wires are necessary to provide a drive signal from a drive circuit to the piezoelectric elements.

In contrast, amended independent claim 1 recites that transmission of the drive signal from the conductor pattern to electrodes of the piezoelectric vibrator is effected only by the support member so that no conductor wires extend from the substrate to connect the drive circuit and the piezoelectric vibrator. Thus, according to the present invention embodied in amended independent claim 1, the support member not only supports the piezoelectric element on a substrate, but also transmits a drive signal to the piezoelectric element so that additional conductor wires are not needed. Thus, in addition to facilitating efficient transfer of vibration from the piezoelectric vibrator to the movable member, the claimed invention eliminates the need for conductor wires separate from the support member by providing a support member capable of serving as a conductive path. Again, no corresponding structural and functional combination

is disclosed or described by Yamaguchi which requires separate conductor wires to provide a drive signal from a drive circuit to the piezoelectric elements as set forth above.

In the absence of the foregoing disclosure recited in independent claim 1, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to establish unpatentability of the claimed invention anticipation under § 102 can not be found."); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by Katsuma and Yamaguchi for the reasons stated above. Furthermore, Katsuma and Yamaguchi does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in

the art to modify Katsuma's or Yamaguchi's ultrasonic motor to arrive at the claimed invention.

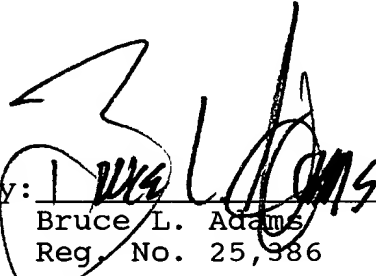
Claims 2, 4, 6, 7 and 9 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from Katsuma and Yamaguchi at least in the same manner as claim 1.

In view of the foregoing, applicants respectfully request that the rejections of claims 1, 2, 4, 6, 7 and 9 under 35 U.S.C. §102(b) as being anticipated by Katsuma or Yamaguchi be withdrawn.

In view of the foregoing amendments and discussion,
the application is now believed to be in condition for
allowance. Accordingly, favorable reconsideration and
allowance of the claims are most respectfully requested.

Respectfully submitted,

ADAMS & WILKS
Attorneys for Applicants

By: 
Bruce L. Adams
Reg. No. 25,386

17 Battery Place
Suite 1231
New York, NY 10004
(212) 809-3700

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